

Our author is at his best when he comes to deal with the genius of Burns, to whom the hills and woods were not merely enjoyable scenes to be visited and described, but became part of his very being; who found in their changeful aspects the counterpart of his own variable moods, and whose feelings found vent in an exuberance of appreciation which had never before been heard in verse.

He touches lightly the descriptive passages in Scott and Wordsworth, and the ballad singers of the border, who, though mostly inspired by war-like achievements, often wove into their tales a thread of tender affection and romance. In the poems attributed to Ossian, although Highland scenery is not specially described, it forms a visible and changing background.

Our author turns from the consideration of the influence exerted by the geographical features of a country upon the development and habits of thought of its inhabitants to the discussion of the origin of those features themselves. This is a subject which has of recent years received much attention both in this country and in America. Our author describes the scenic features under several heads. Mountains and valleys may be considered as correlatives, the mountains being there because the valleys have been scooped out between them. Under lakes, we turn with interest to his views on the glacial erosion of rock basins, which he holds could be effected by land ice only. He makes, however, the qualifying remark that a terrestrial surface of crystalline rock, long exposed to the atmosphere or covered with vegetation and humus, may be so deeply corroded as for two or three hundred feet downward to be converted into loose detritus, and the ice may thus have had much of its work done for it, and would be mainly employed in clearing out the corroded débris. Whether, however, this will explain many of the rock basins of the British Isles is not very clear.

In another essay he shows what Hutton did by his theory of the earth to pave the way for the accurate scientific treatment of all those questions of the changes which the earth has undergone in attaining its present configuration. Playfair, Hall, and others helped on the work. The obvious question arising out of such speculations is, how long must it have taken to bring about such great results? and thus we are taken through the controversies as to whether uniform change, which we observe, or local and intermittent catastrophic action, of which we see proofs everywhere, have done most to bring about the results in every individual case. The physicists tell us that from a consideration of the rate at which the earth parts with its heat, of the limitation of the age of the sun, of the retardation of the earth's angular velocity by tidal friction, they are not prepared to allow such a vast age as geologists have claimed for the earth. The geologists, on the other hand, having regard to the rate at which changes on its surface are observed to be brought about by existing agents, and the time demanded for the evolution of living things, insist upon a much larger estimate of time than the physicists are prepared to allow. The con-

fidence reposed in the accuracy of such inferences must depend upon the probability or improbability that the observer has seen enough to justify his generalisations, and that no contradictory evidence can be forthcoming.

The geologist and physicist will probably arrive at a compromise when the one admits that his calculations, based on the rate of waste, may be entirely vitiated by earth movements, which will either hurry on or retard such waste, and that life will change more rapidly with the changes of environment produced by earth movements, and when, on the other hand, the physicist has corrected his estimate of the rate at which the earth is cooling by taking more careful account of the variety of conducting material of which the earth is composed, has estimated the planetary fuel for ever being thrown into the sun from space, to say nothing of the new views of radioactivity, and has re-considered his inferences from tidal friction, which some of our highest mathematicians admit is still open to doubt.

Such speculations suggest the name of the great apostle of evolution, and an essay on the life and work of Charles Darwin follows, while a biographical sketch of Hugh Miller is fitly introduced among essays which so largely deal with the influence of a man's environment upon his imagination and writings.

In an age like this, when the relative place and value of technical and literary training are so strongly forced upon the attention of the country, an essay on science in education by one whose experience and outlook are so wide will be welcomed. Then, to bring us back to the main subject with which he commenced, he gives an interesting sketch of the building up and moulding of the Campagna and the surrounding country, fitting it for the site of many an ancient city, and at last for the eternal city so long the centre of the world.

A MAGNETIC SURVEY OF JAPAN.

A Magnetic Survey of Japan reduced to the Epoch 1895.0 and the Sea Level. Carried out by order of the Earthquake Investigation Committee, reported by A. Tanakadate. Pp. xii+347 and plates. (Published by the University, Tokyo, Japan, 1904.)

THE completion of the detailed magnetic survey of a country is a task requiring great skill and industry. We congratulate Prof. A. Tanakadate and his colleagues on the successful accomplishment of a heavy piece of work, which will be welcomed by all who are interested in the science of terrestrial magnetism. The work is the result of the voluntary cooperation of sixteen observers, of whom seven are professors or assistant professors of the Imperial University, Tokyo, the others also occupying responsible positions. Prof. Tanakadate modestly only claims for himself the position of a "reporter" who has collected the work of the different parties, but we imagine that we owe to him also the detailed discussion of the results which forms an essential portion of the volume before us.

A clear account is given in the initial paragraphs of the method of observations and the instruments used, but not too much space is devoted to these details, so that the reader is soon brought to the first difficulty which occurred in the working out of the observations. It was necessary, in order to reduce them to a common epoch, to take account of secular variations. This might most easily have been done by choosing as observing stations the same places at which the magnetic elements had been determined in a previous survey, but in attempting to carry this out it was found that the changes which had taken place in their surroundings made it impracticable to observe at most of the old stations. Some other method of reduction had therefore to be adopted. Empirical expressions were found for the magnetic elements in terms of longitude and latitude similar to those deduced by Prof. Knott for the previous survey. A comparison of the two expressions gave the secular variation. The results of all the observations for each station are given in the report. The reduction of the observations to sea level is always to some extent arbitrary. The process employed in the present case, where use is made of relations given by the theory of the potential between the radial variation of the horizontal components and the horizontal variation of vertical force, is an improvement on the more empirical methods which have sometimes been adopted.

A further application of the potential theory may serve as an important check on the accuracy of the observations. If a potential exists, the rate of variation of the northerly force towards the west must be equal to the rate of variation of the westerly force towards the north. If this relation does not hold, the earth's magnetism cannot be completely represented by a potential, and this would mean that vertical electric currents traverse the earth's surface. The authors of the present survey calculate the intensities of these vertical currents, but rightly do not attach much importance to them. They are much greater than observations on atmospheric electricity allow us to contemplate as possible. We may therefore take the calculated values of these currents to be indications of the extent of uncertainty in the observations.

We must refer the reader to the original for the discussion of local disturbances, but cannot avoid directing attention to one passage, which seems to indicate some kind of misapprehension on the part of the author.

"It is often erroneously believed," he says, "that the expansibility of the earth's magnetic potential in negative powers of the radius vector is a proof that the source of action is inside the earth."

In a preceding sentence the writer connects his supposed error with the fact that "inasmuch as the surface integral of the force over the earth vanishes, the so-called seat of action may be placed either inside or outside."

In this passage the author seems to doubt a well-established theorem which is quite independent of the question whether the surface integral of normal force when taken over the whole surface of the earth has a finite value or not.

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To put the matter plainly: If the magnetic forces at all points of the surface of a sphere can be represented in terms of a potential which is expressed as a series of spherical harmonics proceeding by negative powers of the radius vector, then there are no magnets or electric currents outside the sphere. If the passage quoted is intended to deny the truth of this proposition, the author is guilty of a heresy which he does not justify either by his hydrokinetic analogy or by his reference to one of Lord Kelvin's papers. It should be said, however, that in other parts of his volume the author seems to adopt Gauss's reasoning as to the discrimination between outside and inside effects by spherical harmonic analysis. It may be, therefore, that the apparent meaning of the passage is not the one which it was intended to convey. It is of some importance to avoid misunderstanding on so important a matter, and it is for this reason that I feel compelled to direct attention to the only criticism which can fairly be raised with regard to a very meritorious and heavy piece of work.

May other countries follow this example of Japanese enterprise, and may, especially in English colonies, scientific men receive such help from their Governments as will enable them to keep pace with foreign nations in the successful prosecution of similar work. It is not the enterprise or the knowledge which is wanting, but the material assistance and the official recognition that a certain duty is imposed on each country to take its share in the working out of geophysical problems.

ARTHUR SCHUSTER.

THE TECHNOLOGY OF THE VEGETABLE FIBRES.

The Spinning and Twisting of Long Vegetable Fibres (Flax, Hemp, Jute, Tow, and Ramie). By Herbert R. Carter. Pp. xvi+360. (London: Chas. Griffin and Co., Ltd., 1904.) Price 10s. net.

WORKS written for the textile industries may be divided into three classes, viz. descriptive works of a more or less technical and practical character, educational works leading students up to an appreciation of the difficulties to be faced, and works which combine the descriptive and educational but which too frequently meet the requirements of neither manager nor student. The work under consideration meets the requirements of the mill manager or advanced student in a manner perhaps more than satisfactory. On the other hand, to place such a work as this in the hands of the elementary student would be anything but satisfactory, rather suppressing than developing that genuine interest without which it is impossible for the student to make true progress in his studies. In its particular line, however, we must highly commend the work as representing up-to-date practice in most of the sections of the textile industries of which it treats.

The work is really arranged in four sections, the first three chapters being devoted to general particulars respecting the fibres in question, chapters iv. to xv. dealing with the mechanical processes necessary for the formation of the said materials into satisfactory yarns, chapters xvi. and xvii. referring to